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# **A Capital Mistake? The Neglected Effect of Immigration on Average Wages**

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# **A capital mistake? The neglected effect of immigration on average wages**

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Much recent literature on the wage effects of immigration assumes that the return to capital, and therefore the average wage, is unaffected in the long run. If immigration is modelled as a continuous flow rather than a one off shock, this result does not necessarily hold. A simple calibration with pre-crisis US immigration rates gives a reduction in average wages of 5%, larger than most estimates of its effect on relative wages.

Keywords: immigration, average wage, capital stock, labour force growth

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## I. Introduction

In recent years, there has been a vigorous debate over the impact of immigration on the US labour market, particularly regarding the wages of unskilled native workers. A common exercise in the literature (Borjas, 2003; Borjas and Katz, 2005; Ottaviano and Peri, 2005, 2006, 2008; Aydemir and Borjas 2006) is to assume a multi-level Constant Elasticity of Substitution (CES) production function for the US economy, with the labour input sub-divided by education, experience and (in some cases) migration status. Estimates of the elasticity of substitution between different groups of workers combined with the supply of immigrants in each group are used to find the effect of immigration on relative wages. The latest estimates of the long run effect on US born high school dropouts are between +0.3% (Ottaviano and Peri, 2008) and -3.8% (Aydemir and Borjas, 2006). This is only a small share of the observed 24.4% fall in this group's wage, relative to the average, between 1990 and 2004 (Ottaviano and Peri, 2006, p. 32).

The *absolute* effect of immigration on wages, however, also depends on the behaviour of the capital stock. The literature usually assumes a constant return to capital in the long run, which implies that immigration does not change the average wage (of natives and immigrants combined).<sup>1</sup> Ottaviano and Peri (2006, p. 10) give the most explicit justification: 'As for the long-run response of capital, any model of growth (Solow, 1956; Ramsey, 1928) as well as empirical evidence imply that capital adjusts to maintain its real return (and capital output ratio) constant.' Under this assumption, the changes in relative wages are all that needs to be considered in the long run.

This approach, however, implicitly treats immigration as a one-off shock, which increases the size, but not the growth rate, of the labour force. While this may be appropriate for particular episodes such as the Mariel boatlift (Card, 1990), it is clearly

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<sup>1</sup> The CES framework makes changes in average and relative wages additive.

not an accurate description of migration in general.<sup>2</sup> Once immigration is treated as a continuous flow, adding a little bit to the population every year, it can be seen that immigration increases the growth rate of the labour force, reducing the capital stock per worker on which the average wage depends. In Part 2, I derive the effect of a change in labour force growth on the average wage in a Solow–Swan model. Part 3 is a simple back of the envelope calculation of the size of this effect in the United States, which implies a reduction of around 5% in the average wage. Part 4 concludes.

## II. Theory

Consider the standard Solow–Swan model e.g. in Romer (2006, ch. 1), with a Cobb–Douglas production function in aggregate labour  $L$  and capital  $K$  as in Ottaviano and Peri (2008),

$$Y = (AL)^\alpha K^{1-\alpha} \quad (1)$$

The equation of motion for the capital stock is  $\frac{\partial K}{\partial t} = sY - \delta K$  where  $s$  is the savings rate and  $\delta$  is the depreciation rate. The steady state with a constant capital stock per *effective* worker  $K/AL$  is given by

$$s \frac{Y}{AL} = (\delta + n + g) \frac{K}{AL} \quad (2)$$

where  $n$  and  $g$  are the growth rates of the labour force  $L$  and labour augmenting productivity  $A$  respectively. Combining Equations 1 and 2 allows us to express the capital stock per actual worker  $K/L$  as

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<sup>2</sup> Ottaviano and Peri (2006, p. 10): ‘Immigration is an ongoing phenomenon, distributed over years, predictable and rather slow . . . It is reasonable, therefore, to think of this issue more dynamically with investments continuously responding to the flow of immigrant workers.’

$$\ln\left(\frac{K}{L}\right) = [\ln(sA^\alpha) - \ln(\delta + n + g)] \quad (3)$$

The partial derivative of Equation 3 with respect to labour force growth is

$$\frac{\partial \ln(K/L)}{\partial n} = \frac{-1}{\alpha(\delta + n + g)} \quad (4)$$

Now, setting the (average real) wage  $w$  equal to the marginal product of labour from Equation 1, the elasticity of  $w$  with respect to the capital stock per worker is

$$\frac{\partial \ln w}{\partial \ln(K/L)} = (1 - \alpha) \quad (5)$$

Combining Equations 4 and 5 using the chain rule gives

$$\frac{\partial \ln w}{\partial n} = \frac{-(1 - \alpha)}{\alpha(\delta + n + g)} \quad (6)$$

the semi elasticity of the average wage with respect to the population growth rate, which is the percentage change in the wage resulting from a one percentage point increase in labour force growth. This is a level effect – in the new steady state the wage will continue to grow at rate  $g$  but on a permanently lower path.

### III. Empirics

How big a fall in the average wage is implied by recent US immigration rates in this framework? Romer (2006, p. 25) gives a labour share  $\alpha$  of  $2/3$  (c.f. 0.67 in Ottaviano and Peri, 2008, p. 12), and depreciation plus population and productivity growth ( $\delta+n+g$ ) of 0.06, implying a value of  $-8\frac{1}{3}$  for the semi elasticity in Equation 6. Legal migration of people aged between 15 and 64 to the US was around 1 million per year for fiscal years

2004 through 2006 (Office of Immigration Statistics 2007).<sup>3</sup> In addition Hanson (2006, p. 7) estimates a net illegal inflow of 350 000 to 580 000 per year. In 2006 the size of the civilian labour force was 151 million with a participation rate of 66.2% (Bureau of Labour Statistics, 2008). The same ratio applied to immigrants (probably an underestimate, particularly for illegals) would mean an annual addition of about 1 million – between 0.59 and 0.69 percentage points – to labour force growth, implying that immigration reduces the average wage in the steady state by between 4.9% and 5.8%. This is larger than the maximum 3.8% fall in dropout wages, relative to the average, mentioned in the Introduction.

One might wish to adjust the size of the labour force upwards for the illegal resident population. The Department of Homeland Security (2006) estimates this at 10.5 million in 2005. Rounding up to 11 million for 2006 and applying the same participation rate as above would only lower the average wage effect to -4.7%. To the extent that illegal immigrants are already included in the labour force statistics (plausible since it is assumed that most are captured by the census), however, this adjustment is unnecessary.

The above analysis assumes a closed economy with respect to capital. Will investors respond to lower wages and higher profits with capital inflows that restore the previous rate of return? The United States is surely too large to be a price taker in international capital markets, even if capital was perfectly mobile. Furthermore, much of the capital inflow in the relevant period was driven by foreign central banks, which would not automatically increase their holdings of US assets in response to a fall in US wages.<sup>4</sup> Even if capital mobility eliminated a majority of the effect of migration on the

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<sup>3</sup> 2006 is used to avoid the effects of the US housing crash and following recession, as well as for compatibility with the preceding literature.

<sup>4</sup> Capital could even flow the other way if lower US wages make its tradables more competitive, reducing the trade deficit at a fixed exchange rate and therefore lowering foreign central banks' accumulation of US dollar reserves.

average wage, there could still remain an impact of comparable size to the changes in relative wages estimated in the literature.

Another objection might be that the lack of variation in the capital-labour and capital-output ratios shown in Ottaviano and Peri (2006, p.p. 30, 50) rules out significant effects from immigration. However, these ratios only show convergence to a long run trend without specifying the determinants of that trend. A lower rate of immigration would have meant a different steady state, with slower labour force growth and higher capital-labour and capital-output ratios. This point is given further force when one considers that the 1960s and 1970s were a time of particularly strong growth in the native labour force as the baby boomers moved into the labour market (see e.g. Bureau of Labour Statistics, 2008). High immigration in more recent decades may be considered as merely picking up the slack, i.e. preventing a large decline in the growth rate of the labour force, which would have had the results mentioned above.

#### **IV. Conclusion**

The effect of immigration on native wages depends crucially on the behaviour of the capital stock. Modelling immigration as a one off shock, as is done in the literature, minimizes its effects by implying that the average wage is unchanged in the long run. Treating immigration more realistically, as a continuous flow, reveals that it changes the rate of growth of the labour force, which affects the capital stock per worker and thus the average wage, even in the long run. A simple calculation of this effect in a Solow–Swan model implies that pre-crisis sized US immigration flows would reduce the steady state average wage by around 5%. Even if the assumption of a closed economy makes this an overestimate, it suggests that the effect of immigration on average wages may be of the

same order of magnitude as the relative wage effects which have received so much attention. Finally, it is perhaps worth repeating that the closed economy Solow–Swan model, while simple, is the same model used in the literature to justify the assumption of a constant rate of return on capital, and it is therefore appropriate to use it in a comment on that literature.

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